

**Comparing Susceptibility and Behavior in Recreational and Occupational Risk Environments:
Implications for Promoting Safety**

*Conference Proceeding for 2015 National Communication Association
Health Communication Division*

Emily Joy Haas, PhD (corresponding author)
Behavioral Research Scientist, Human Factors
National Institute for Occupational Safety and Health (NIOSH)
Office of Mine Safety and Health Research
PO Box 18070, Cochrans Mill Road
Pittsburgh, PA 15236
Phone: 412-386-4627
EJHaas@cdc.gov

Marifran Mattson, PhD
Head, Brian Lamb School of Communication & Full Professor
Purdue University
100 N. University Street
West Lafayette, IN 47906
MMattson@purdue.edu

Abstract

Although internal factors such as age, gender, and experience that influence risk perceptions are frequently studied to better understand human behavior, external factors including social, cultural, and institutional, also influence risk perceptions and behaviors. To better understand these external risk factors and further our understanding of ways to efficiently target, tailor, and promote safety messaging to at-risk populations, a qualitative approach to risk assessment within individuals' applied, situational contexts was undertaken. Two qualitative studies obtained data from two populations, motorcyclists and mineworkers, about their risk perceptions and subsequent behaviors within their respective, dynamic environments. Semi-structured interviews were completed with 37 motorcyclists and 18 mineworkers. A comparative thematic analysis of the motorcyclist and mineworker data showed support for previously identified internal factors that often influence risk perceptions and behaviors and revealed interesting similarities in how external factors within each setting positively and negatively influence their risk perceptions and risk behaviors. Based on these similarities, it is possible to consider broader approaches for communicating about health and safety with populations that engage in risk-taking behaviors within high-risk environments to support and manage safer behaviors. Additional research is necessary to help mitigate the social, cultural, and structural barriers associated with risk perceptions and subsequent decision making.

Keywords: Health communication, injury prevention, interviews, mine health and safety, motorcycle safety, risk perceptions

Comparing Susceptibility and Behavior in Recreational and Occupational Risk Environments:
Implications for Promoting Safety

Perceptions of risk can have a strong influence on individuals' recognition of hazards, decision making, and safety behaviors (Cummings, Becker, & Maile, 1980; Diefenbach, Weinstein, & O'Reilly, 1993; Rundmo, 2001; Weinstein, 1987). Although internal factors that influence risk perceptions are frequently incorporated into research to better understand human behavior, research focusing on common external, or environmental, factors that influence risk is more limited in the literature (Sjöberg, 2000). It is important to study and address possible external factors, including if they vary in different environments, in an effort to further our understanding of ways to efficiently target, tailor, and promote safety messaging to at-risk populations. This paper reports results that compare two at-risk populations—motorcyclists and mineworkers—and their risk perceptions and risk-taking behaviors during respective recreational and occupational decision-making tasks. First, we provide a brief review of internal and external factors that may influence risk perceptions and behaviors. After providing justification for including and comparing these two populations, a discussion of the methods and results is provided. Based on the results, we provide insight into communication messages and mediums that may be most effective to reduce accidents and injuries for at-risk populations on and off the job. Considerations for future risk communication and messaging, taking into account external factors that commonly influence behavior, also are provided in an effort to improve health and safety promotion and reduce injury among populations who consistently encounter hazardous situations.

Internal Factors that Influence Risk Perceptions

Internal factors including age, gender, and experience are frequently incorporated into individual risk perceptions and decision-making research (e.g., see Butani, 1988; Deery, 1999; Mullin, Jackson, Langley, & Norton, 2006; Olofsson & Ohman, 2015; Siu, Phillips, & Leung, 2003). Such research

more often considers risk perceptions quantitatively, using various risk paradigms to reveal what personal characteristics contribute to individual risk perceptions and behaviors. In general, research has shown that more specific, task-based experience is associated with less risk susceptibility (Barnett & Breakwell, 2001). For example, industrial safety research shows that young male workers are at a greater risk for injury than other workers (Salminen, 2004; Breslin, Koehoorn, Smith & Manno, 2003). Studies attribute this higher injury rate to young males' willingness to take more risks and feeling more vulnerable to peer pressure. Additionally, young male workers often do not rank safety a high priority nor place injury in the forefront of their decision making processes, which increases their likelihood of injury (Beharie, 2003). Research in traffic safety shows similar trends, revealing age as an emergent factor that influences perceived invulnerability (Zuckerman, 1994).

These results show that risk perceptions and risk-taking behaviors can be largely dependent on individual differences in personality – including sensation seeking, age, impulse, vulnerability, personal experience, cognitive development, and self-efficacy (Bonaitu, Breakwell, & Cano; 1996; Breakwell, Millward, & Fife, 1994; Bromiley & Curley, 1992; Brown, 2003; Mullin, Jackson, Langley, & Norton, 2006; Weinstein, 1989; Zuckerman, Ball, & Black, 1990). Knowing these internal factors may influence perceived risks is useful for targeting specific sub-groups; however, it is unclear why and how much of an effect these personal factors have on decision making when situated within different environments.

Incorporating External Factors that Influence Risk Perceptions

Interestingly, research indicates that when external factors are taken into account, internal factors such as age and gender are not as significantly associated with higher injury rates (McCloskey, 2008). Organizational and systematic reviews have alluded to workplace or other external factors being more influential than individual factors (Cohen & Cleveland, 1983; Cohen & Jensen, 1984; Pidgeon, 1991; Zohar, 1980). For instance, root cause analyses of workplace accidents and vehicular injuries have been

attributed to a range of factors including human error, improper use of or lack of personal protective equipment (PPE), production pressures from management, peer pressure to engage in risky behavior, and other workplace and/or environmental barriers to safety including limited visibility in their environment (Irizarry & Abraham, 2006; Lajunen & Räsänen, 2004, 2001; Perlman, Sacks, & Barak, 2014; Thomson, 1980; Webel, Okonsky, Trompeta, & Holzemer, 2010; Weyman & Clark, 1999). However, less is known about why and how these external factors influence individual risk and behavior.

Although a variety of known internal and some external factors are documented in the literature, methodological research barriers have prevented a more nuanced understanding of risk perceptions and behaviors. First, Weinstein (1987) argued that convenience sampling with the same types of populations, such as accessible college-aged students, has contributed to stagnancy in what we know about risk perceptions in varying environments. Consequently, there is little explanation as to if and why certain individuals and groups might differ from one another regarding their perceptions of risk (Barnett & Breakwell, 2001). In response, researchers need to venture into more applied settings to understand true environmental hazards and mitigation strategies.

Second, because previous research has focused more on large sample recruitment and aggregate level data, suggestions encourage an emphasis on the social, cultural, and institutional factors that influence risk during daily, routine activities (Sjöberg, 1995; Turner & Wynne, 1992). Similarly, Pidgeon (1999) suggested that, even though it is difficult to categorize individuals to help predict differences in risk perceptions, it is necessary to understand the contexts (i.e., the environments) in which these different factors have the most impact. Additionally, it is important to understand and acknowledge these external contexts – whether they are organizational or environmental – because, despite all of the individual-level theories (e.g., Health Belief Model, Protection Motivation Theory, Extended Parallel Process Model) that incorporate risk perceptions, no simple relationship exists that

links perceptions of risk and mortality/morbidity incidents, indicating that people do not always perceive, interpret, or act on risk information in a way that we may predict (Nelkin, 1989).

Finally, risk data are primarily collected quantitatively. Using a qualitative approach may help further analyze and understand the external factors present within individuals' environments to determine any similar or varying external factors that influence risk and behavior. For example, although feelings of risk often rank low in survey results, qualitative research, including in-depth interviews with at-risk individuals, can reveal their actual concerns about unsafe environments (e.g., see Freiman, 2003; Zakocs et al., 1998). Also, although quantitative studies that utilize the aforementioned theories to assess risk often render significant results, the effect sizes tend to be small (e.g., see Brewer et al., 2007; Floyd, Prentice-Dunn, & Rogers, 2000; Harrison, Mullen, & Green, 1992). Results from such studies have caused some researchers to argue that survey assessments of risk perceptions do not accurately estimate the true association between perceived risk and the behaviors carried out by individuals (Brewer et al., 2007). In response, a more narrative, qualitative approach to risk assessment and response within individuals' applied, situational contexts warrants attention in the literature.

Rationale for Comparison of At-risk Populations

The current project utilizes motorcyclist and mineworker populations to compare and contrast risk perceptions and behaviors. The purpose of this comparison was to understand if and how recreational and occupational circumstances impact the social, cultural, and institutional factors that influence risk perceptions and behaviors during routine activities. These populations have been addressed in related research due to first, the risk propensity involved with these tasks (Butani, 1988; Deery, 1999; Haas, Mattson, & Kosmoski, 2012; Mullin et al., 2000; Weyman, Clark, & Cox, 2003) and second, their association with being marginalized in terms of needing additional prevention resources (Haas, 2012; Raeburn & Beaglehole, 1989). Research has studied internal factors that contribute to individual risks for both motorcyclists (Elliot, McColl, & Kennedy, 2003) and mineworkers (Kowalski-

Trakofler et al., 2004; Peters, Vaught, & Mallett, 2010) because these populations are challenged by continuously changing environments and newly emerging hazards. Because similarities exist between these two populations in terms of hazard recognition and response, comparable safety training methods have been used to educate motorcyclists and mineworkers (e.g., see Liu et al., 2009; Tichon & Burgess-Limerick, 2011).

Both settings in which these groups behave are considered dynamic and that dynamism contributes to accident and fatality rates. Because recognition, perception, and response are critical for both of these populations to maintain personal health and safety, they were deemed appropriate populations for comparison. Interview data with participating motorcyclists and mineworkers were analyzed and compared to identify similarities and differences in critical external influencers.

Methods

Two qualitative studies obtained detailed information from two at-risk populations, motorcyclists and mineworkers, about their risk perceptions and subsequent behaviors either while driving a motorcycle or completing a job task at their mine site. The sample included 37 motorcyclists and 18 mineworkers. In the current study, these two data sets were thematically analyzed and compared. Human subjects research approval from the Institutional Review Boards (IRB) at a Midwestern University and the National Institute for Occupational Safety and Health (NIOSH) were received to recruit at-risk motorcyclists and mineworkers in both underground coal and surface industrial minerals, respectively.

Interview Instrument

Semi-structured interview guides, containing slightly different terminology to resonate with each population, were developed using theoretical and empirical research on risk perceptions and health behaviors. Theoretical constructs within the Health Belief Model (Janz & Becker, 1984), Reconceptualized Health Belief Model (Mattson, 1999), Harm Reduction (Haas & Mattson, 2014), Dual

Process Thinking (Kahneman & Frederick, 2005), Protection Motivation Theory (Rogers, 1975), and the Precaution Adoption Process Model (Weinstein, 1988) were referenced to devise questions about mineworkers’ and motorcyclists’ risk perceptions, self-protective intentions, and safety behaviors.

Sample questions are listed in Table 1.

Table 1. Sample interview questions probing risk perceptions and risk behavior

<i>When driving your motorcycle...</i>	<i>When doing your job at the mine...</i>
<ul style="list-style-type: none"> • What are some common hazards you watch for while driving a motorcycle? • How often do you engage in risky behaviors while driving a motorcycle? • How often do you follow/ignore traffic rules? • What is the likelihood of an accident happening to you while driving a motorcycle? • What would be the consequences of such an accident? • What is your risk of experiencing an accident versus your fellow motorcyclist? • Have you experienced a motorcycle accident as a result of risky behaviors? • What are some ways that other motorcyclists support safer riding? 	<ul style="list-style-type: none"> • What are some common hazards you watch for while doing your job? • How often do you engage in risky behaviors on the job? • How often do you follow/ignore workplace safety rules? • What is the likelihood of an accident happening to you at work as a result of your behavior? • What would be the consequences of such an accident? • What is your risk of experiencing an accident versus your coworker’s risk? • Have you experienced an accident as a result of risky behaviors? • What are some ways that management supports safe work behaviors?

Motorcyclists

The rate of motorcycle accidents has increased disproportionately compared to other types of traffic accidents, leading to calls for more emphasis on motorcycle accident prevention (Centers for Disease Control and Prevention (CDC), 2012; National Highway Traffic Safety Administration (NHTSA), 2010). On a national level, while motor vehicle accidents have decreased, motorcycle-related deaths have increased 150% from 1997 to 2008 (NHTSA, 2014; Wilson, Stimpson, & Hilsenrath, 2009). After a slight decline in more recent years, 4,597 motorcyclists were killed in crashes in 2012, a seven percent increase from 2011 (NHTSA, 2014). Additionally, motorcycle injuries increased fifteen percent from 2011 to 2012 (NHTSA, 2014). More accidents, injuries, and fatalities could be due to the increase in motorcycle sales over the years, mainly in response to the overall rising of gas prices (Motorcycle Industry Council, 2006; Wilson et al., 2009). Additionally, more recent statistics show the percentage of motorcyclists involved in accidents who have a blood alcohol content (BAC) above the legal limit is continuing to increase while the use of helmets is slightly decreasing (NHTSA, 2014). Research has examined motorcyclists' hazard perceptions and risk recognition while driving a motorcycle (e.g., see Haas et al., 2012; Rosenbloom, Perlman, & Pereg, 2011; Symmons, Mulvilhill, & Haworth, 2007) but little research has specifically compared these perceptions and behaviors to other groups.

Motorcyclist recruitment. Motorcyclists were recruited using maximum variation sampling (Lincoln & Guba, 1985). This approach allowed for the inclusion of younger, older, male, female, novice, intermediate, and experienced motorcyclists who operated a variety of motorcycles. Participants were recruited through posted flyers, online flyers, network sampling, and snowball sampling (Miles & Huberman, 1994; Lindlof & Taylor, 2002). Interviews were conducted at bars, participants' homes, institutions of higher education, motorcycle rides, and participants' businesses between June 2011 and September 2011.

Interview procedure. If motorcyclists reported (1) engaging in at least one of five risky behaviors (Kosmoski, Mattson, & Hall, 2007) including, does not wear a helmet; minimal or no safety gear; speeds; consumes alcohol before driving a motorcycle; and/or been in at least one near-miss crash or been in a crash; and (2) at least 18 years of age, they were eligible to participate. Each individual was read and provided informed consent before participating in an interview.

Participants. Of the 37 motorcyclists who participated, twenty-nine ($n = 29$) were male and eight ($n = 8$) were female. The participants ranged in age from 18 to 70 ($M = 40.5$). Years of experience riding a motorcycle ranged from six months to 54 years ($M = 17.5$). Participants were residents of 13 different cities within nine counties throughout one midwestern state. Eighteen of the motorcyclists reported driving Harley-Davidson type motorcycles and the remaining 17 were currently operating a crotch rocket-style motorcycle. Interviews lasted from 25 to 65 minutes, depending on the experience of the motorcyclist, knowledge of particular traffic hazards, and behavioral response to those hazards. Each interview was transcribed in a timely manner to allow for recognition of theoretical saturation, which became apparent after the thirtieth interview (Corbin & Strauss, 2008).

Mineworkers

In underground coal mines, workers who operate remote-control continuous mining machines (CMM) have the highest incidence rate of injury in the mining industry (Mine Safety and Health Administration, (MSHA) 2014). As of May 2014, the mining industry experienced 38 fatal crushing or pinning accidents that involved a risky placement of a CMM operator while operating these machines (MSHA, 2014). Besides safety risks, mining also exposes workers to health risks. Specifically, mining is one of the leading industries for occupational exposure to respirable silica dust (Healy, Coggins, Tongeren, MacCalman, & McGowan, 2014; Hewett, Morey, Holen, Logan, & Olsen, 2012; Kreiss & Zhen, 1996; Scarselli, Binazzi, Forastiere, Cavariani, & Marinaccio, 2011; Vacek, Verma, Graham, Callas, & Gibbs, 2011). Bagging operators represent the occupation with the highest number of

silicosis-related deaths, and account for about sixteen percent of the U.S. deaths due to silicosis (NIOSH, 2003). Overexposure to silica dust for a prolonged period of time can lead to silicosis.

Alarming, research has shown an increasing trend in the number of younger workers, with relatively little mining experience, being diagnosed with silicosis or a related respiratory disease (Laney, Petsonk, & Attfield, 2010). Therefore, these two sub-groups (i.e. underground CMM operators and surface bagging operators) were recruited and interviewed.

Mineworker recruitment. Mine sites were targeted using convenience and snowball sampling with previously established mine contacts (Miles & Huberman, 1994). Eighteen safety managers at 16 mine sites were contacted via e-mail or phone and explained the purpose of the study. Five of these individuals presented the information to their employees. Two of the individuals had contact with more than one mine site and helped recruit participants from other locations as well. As a result, 18 individuals from seven locations participated between January and July 2014.

Interview procedure. Potential participants were provided with a written and verbal explanation of the study at which point they could agree or disagree to participate. All of the interviews were conducted at a facility on the surface of a mine site or at a mine safety training academy to respect anonymity of the mine site. One researcher served as the primary interviewer and took notes during each interview. A second researcher joined the interviewer for 11 of the 18 interviews and took notes or asked probing questions.

Participants. Nine CMM operators from five underground coal mines and nine bagging operators from two surface industrial mineral mines participated. Of these 18 mineworkers, 3 participants were under 30 years of age; 5 were 30 to 39 years of age; 3 were 40 to 49 years of age; and 7 were 50 years or older. All participants were male. All participants had experience in other mine positions (e.g., roof bolter, scoop operator, shuttle car/haul truck driver, bulk loader). Participants' mining experience ranged from 3 to 37 years ($M = 19.4$ years). Interviews lasted from 20 to 60 minutes,

depending on the experience of the worker, his knowledge of particular mine hazards, and behavioral response to those hazards. Although experience of participants varied, similarities across their knowledge, attitudes, and behaviors emerged relating to risk perceptions, reaching saturation of data by the end of recruitment at the participating mines (Corbin & Strauss, 2008).

Data Analysis

Previous, separate thematic analyses of this data resulted in two codebooks that contained an organized collection of the themes, codes, definitions, and examples from the respective interview data to support the collection and reporting of organized information for both motorcyclists (blind citation, 2014; blind citation, 2012) and mineworkers (blind citation, 2015a; blind citation, 2015b). The codebooks for each data set were compiled together and thematically coded for categories or constructs, including cues and patterns in risk perceptions, hazard recognition, risk-taking behaviors, and mitigation strategies either while driving a motorcycle or while on the job. In these analyses, a validation process occurred in which two researchers participated in inter-rater reliability analyses of data (Armstrong, Gosling, Weinman, & Marteau, 1997; Boyatzis, 1998).

Because the same types of questions were asked of both participant groups, these two codebooks were thematically analyzed and compared for consistencies. The thematic analysis process used to structure meaningful codes between these two at-risk groups was guided by Boyatzis (1998) including the ability sense themes, sense them reliably, develop codes, and interpret the information and themes in the context of a conceptual risk perception framework.

Generating a code. Several stages of thematic coding occurred. First, during initial coding the two codebooks were consulted and short sequences of words or sentences were identified that could potentially be meaningful, including patterns of similar perceptions between both groups. Once these common phrases were grouped together relative to a topic for each audience, they were combined into one group and a code was assigned to the topic. Then, more focused coding of the data occurred in

which the researchers further refined the data with respect to the initial codes and research aims. Full passages from the data were read that were noted and assigned during open coding, and linkages within and between codes were further explained for both audiences. After this part, tentative definitions were written for each code assigned.

Reviewing and revising the code. The data were further compared between both groups to look for similarities and differences in what contributed to risk perceptions and safety decisions. Incidents were compared to incidents within the same interview and across interviews, between both groups, to help determine cases in which themes either existed or did not exist in the overall dataset (Boyatzis, 1998; Glaser & Strauss, 1967). For additional reliability, a final reading of the themes and categories was undertaken using a theoretical comparison framework. More specifically, the definitions of the codes were reread in addition to the examples that supported the codes, in relation to previous health theoretical constructs including risk susceptibility and severity, motivation, benefits of and barriers to safety, and self-efficacy (Corbin & Strauss, 2008; Janz & Becker, 1984; Haas & Mattson, 2014; Mattson, 1999). This phase completed the thematic comparison of the two codebooks and as a result, one merged codebook was created that identified similar internal and external factors that influenced motorcyclists' and mineworkers' perceptions of risk.

Results and Discussion

A comparative analysis of the motorcyclist and mineworker data showed support for previously identified internal factors as well as revealed interesting similarities in how external factors within each setting may influence risk perceptions and behavior.

Internal Factors Influencing Risk Perceptions and Behavior

Both mineworkers and motorcyclists tended to perceive their risks of experiencing a negative outcome while driving their motorcycle or working at their mine site to be low. Their perceptions,

which were labeled as optimistic bias, or perceived invulnerability, were associated with internal factors such as more experience and consequently, greater efficacy.

Experience contributing to low risk susceptibility. Although a majority of participants acknowledged that an injury is always possible, they generally referenced their experience as a factor that caused them to feel less susceptible to accidents. Generally, novice motorcyclists and mineworkers had increased feelings and reflections of nervousness. However, more experienced participants often said that with practice, they have become more confident and relaxed in their environment. For example, one mineworker said, “I’ve been doing this for 16 years. I’m pretty experienced and capable. But really, anything is risky in mining so this job is no different. I don’t feel like I am at a bigger risk than anyone else down there. But I also know how to do my job” (Mineworker 1). Similarly, a motorcyclist stated, “I’ve got more miles under my belt so yeah, I picked up some more tricks, and I understand my motorcycles better so I feel more confident” (Motorcyclist 29).

These narratives also demonstrate that with more experience comes more efficacy to make critical, time sensitive decisions. For instance, one motorcyclist said, “I feel like my skills have improved, cause you get experience and you realize what to watch out for and you predict...you start to realize what people are gonna do on the road like when they don’t notice you and stuff like that” (Motorcyclist 23). Along the same line of inquiry, a mineworker noted, “I guarantee that experience level influences safety—the simple fact that they have been around and have seen the “do’s and don’ts” (Mineworker 9). Participants continued to discuss when they first started their tenure as a motorcyclist or mineworker they were a little nervous but then as they gained more experience, and particularly, had not experienced any severe negative consequences, perceptions of susceptibility decreased. This phenomenon is discussed in the literature as underweighting delayed outcomes (Zohar & Erev, 2007). Because these individuals tended to be confident in their decision-making abilities, they also felt a lower sense of vulnerability to risk in their environments.

Age acting as initial barrier to perceived risks and safety behaviors. The results between both groups indicated that older participants reported increased risk susceptibility or probability of experiencing a negative outcome. Those that were younger discussed feeling less prone to being injured at work or on a motorcycle, as illustrated in the comment, “I practiced a lot of risky behaviors when I was really young. But after I turned 20 my risky behaviors declined exponentially. When you’re young you’re always invincible” (Motorcyclist 15). Generally, participants reflected when they were younger they did not realize the potential for accidents as much, but with age and experience, they started to not only recognize, but acknowledge more hazards in their environment. Also, even if participants still expressed some feelings of invulnerability, they tended to predict their behaviors would change with age. For instance, a bagging operator said, “Now I’m not as worried. I don’t know, maybe I’ve just gotten more complacent. But really I’m 31 so I don’t have to worry about dust exposure for another 20 or 30 years. So I think about it but not that much” (Mineworker 10). Similarly, a motorcyclist stated, “Here’s what’s gonna happen...my age will dictate that alone. As I get older I get a little bit smarter about it, it seems like it anyway. You kinda slow down a little bit because you start to think about it more, if you would live if you slammed into something going 75, 80 miles per hour” (Motorcyclist 28).

External Factors Influencing Risk Perceptions and Behavior

Comparing data between both at-risk groups revealed useful information about external factors that influence risk perceptions and behaviors. Specifically, regardless of the environment – road way or mine site – and whether the behaviors were to have fun or get a job done, participants continued to reference social, cultural, and institutional factors within their environments that influence risk and safety behavior. First, the roles of peers within social and cultural facets that act as a mechanism for practicing safer or riskier behavior are reported.

Downward comparisons contributing to low risk susceptibility. Both motorcyclists and mineworkers often compared their situations to that of their peers – whether they were coworkers or

members of the same riding group. Specifically, underground coal mineworkers tended to say that their job was risky, but not as risky as other positions, such as a roof bolter. Likewise, motorcyclists often said even though they engaged in risky behaviors, they were not as risky as the people they ride with from time to time. These responses support previous research showing it is common for at-risk individuals to compare themselves to people who face particularly high or higher risks to make themselves feel safer (Perloff & Fetzer, 1986; Wills, 1981).

In addition, previous risk research has shown that people may claim they have less risk than their peers to help enhance their own self-efficacy (Weinstein, 1984). This concept emerged between both groups as well, who tended to discuss a specific behavior as risky for everyone except them. In general, participants explained they would never do what their peer(s) tried to do – indicating their own behaviors were much safer. For example, when discussing drinking and riding as a risky behavior, one motorcyclist said, “Honestly for me no because I’m, I’m...well I’m a fairly experienced drinker and I limit myself to three beers. So I don’t see that as being a risky behavior because I’m having a max of three beers within a five hour time span” (Motorcyclist 17). Mineworkers had a similar mindset. When a mineworker was asked about standing in an area where workers are not supposed to stand due to the risk for striking injuries, he expressed that, although you’re always weighing the pros and cons when you’re doing it or thinking about doing it [standing in the red zone], your mind usually goes to being more productive than more safe, and that, if necessary, he could react quickly.

Peers/coworkers contributing to safer behaviors. Besides participants comparing their behaviors to those of their peers, they also discussed the perceived social and cultural impact that peers and/or coworkers have on their safety behaviors. Both groups tended to say that for those who are inexperienced in a skill set, positive peer support and expert examples are critical to practicing safety. Regarding setting an example, one mineworker reported his experience learning how to use new technology on the job:

But, when I learned how to run the miner with the proximity detection system, four other people were teaching me. Luckily they taught me how to do everything safely. They have been operators for 5-10 years at least. I had good examples, not risky ones. So I have not witnessed risk-taking although I know it has to happen, people keep getting killed. (Mineworker 4)

Besides discussing the influence of fellow peers, several participants who were older and more experienced indicated they try to encourage others to engage in safer behaviors. For example, one motorcyclist who is 70 years old and has been riding for 54 years discussed ways he tries to be a good example when he rides in a group.

Besides setting a safe example, participants tended to trust the advice of those who had more experience whether it was working in a mine or operating a motorcycle. For instance, a younger motorcyclist who was 20 years old with one year of motorcycling experience said:

When she talks to me about it I'm like okay mom, like I understand but it's not like as serious as my dad's would be because he's ridden and he's...actually he rode that bike too so he knows like how to handle it more and like actually drive it and what to look out for and stuff like that.

(Motorcyclist 23)

Similarly, both groups discussed their experiences as a second or third generation motorcyclist or mineworker. Participants said they had been around the culture forever and trusted the advice of their family or close friends.

Peers/Coworkers contributing to riskier behaviors. Although peers can support safer behaviors, they also can encourage riskier behaviors, which participants discussed as a cultural barrier embedded in their environments. Generally, both groups discussed that, although they have choices, external pressures dictate most of their decisions. One motorcyclist said, "Even if you're an adult it's [peer pressure] just as bad as when you're a kid. Ya know, truly it is. Probably more so" (Motorcyclist 3). Motorcyclists and mineworkers discussed behaviors that were influenced by others. One

mineworker said in reference to avoiding use of safety technology, “It’s just part of the culture and this is how we do it at first.” However, when going against the group norm by not wearing PPE or participating in a riskier activity, participants discussed not feeling accepted by the group. A common comment throughout the interviews was, “it’s the whole culture...that’s what you’re supposed to do.” For this reason, mineworkers and motorcyclists often reference safety behaviors as something that would not easily change unless the culture, whether it is a work group or motorcycling group, changes.

These results support previous research about the impact of peers and the overall culture in which individuals perform tasks. For example, Webel, Okonsky, Trompeta, and Holzemer (2010), conducted a systematic review of 25 peer-based interventions and found that peer-to-peer communication, both in the form of dyad and group, resulted in positive health outcomes for the targeted individual(s) in situations of physical activity, smoking, and self-breast exams. According to the NHTSA (2000), the safety of motorcyclists is influenced by their attitudes toward safety, their efficacy to practice safety, and the influence of their motorcycling peers, including issues such as wearing protective gear and driving a motorcycle while impaired. Similarly, Goodman and Steven (1988) found that positive peer support and trust in coworkers lowered absenteeism of mineworkers and Loughlin and Frone (2004) found that workers’ unsafe behaviors often stem from trying to gain approval from supervisors or peers. In response, positive peer support and a culture that supports safety is critical for populations that already experience hazardous situations, to feel empowered to make safer decisions.

Comfort with environment reducing perceived risk and increasing complacent behavior.

Finally, participants constantly recognized and referenced their dynamic environments – which contain uncontrollable hazards – as a mechanism for increased feelings of risk, constant awareness, and conscious decision making. A majority of participants indicated that a new, more unfamiliar environment, whether it is a new road or new cut of coal in a mine, elevates their feelings of risk. Because a hazard, such as a pothole in the road or unstable mine roof, is a concern with every new

situation, participants discussed the importance of maintaining constant awareness. One mineworker said he could never make assumptions because his environment always changes. Similarly, several motorcyclists discussed the concept of “driving defensively” by being assertive and maintaining awareness of their surroundings at all times, including trying to anticipate other people’s actions.

For instance, a common environmental barrier discussed by both groups was their inability to see hazards clearly. Motorcyclists discussed not riding their motorcycle at night because it was more difficult for them to see and be seen. Similarly, mineworkers said they stand in specific positions so they can both see and be seen better by others. An example provided by mineworkers was high dust volumes. Because dust can impact mineworkers’ visibility while working, participants discussed the risks associated with this condition, including being unseen by another worker.

These results demonstrate that motorcyclists and mineworkers share several similar social, cultural, and institutional factors within their respective environments that positively and negatively influence their risk perceptions and behaviors. Based on these similarities, it is possible to consider broader approaches for communicating about health and safety with populations that engage in risk-taking behaviors within high-risk environments.

Implications for Practice

Results of this study confirm the importance of targeting and segmenting specific at-risk subgroups within target populations and further, tailoring messages for these at-risk groups. Specifically, results show the need for a culture-centric approach (Larkey & Hecht, 2010) that engages the population, to promote health and safety. According to Larkey and Hecht, a culture-centric approach can help reflect and disseminate valid, empathetic, and engaging communication with a higher level of fidelity. In addition, this approach helps foster a centrality that is, “tapped, reproduced, and shared” among an organized group. Based on our results with two distinct groups who experience risk, we argue that strategic, culture-centric communication that takes into account key external factors including when,

who, and what to communicate, may better support health promotion efforts, particularly within organized settings.

When to communicate safety messages? First, results elucidate that younger populations are more likely to ignore safety rules and regulations, perceiving a certain level of invulnerability to hazards and risks. Segmenting younger and more novice individuals to target communication about and encourage safer behaviors, before a specific skill is routinely utilized, is necessary. Based on opinions expressed during the interviews, this communication is critical during any type of training that a novice-skilled individual may receive. Therefore, training should be viewed as a mechanism to change some of the cultural barriers both of these groups discussed. Participants expressed that some type of specific, skill-based training is essential to maintain personal safety. Mineworkers often discussed that, even though training does not prepare you for the nuances of your environment, it prepares you for what to watch for in that environment. Similarly, motorcyclists indicated that during new rider training they learned about what to watch for when first starting out on the road. Therefore, initial communication with groups, before or as they are learning a specific skill, is encouraged to instill an accurate sense of risk perceptions and prevent risky behaviors.

Who should communicate safety messages? Motorcyclists and mineworkers discussed the role of their trainer, supervisor, or more experienced peer in imparting safety skills to them. Motorcyclists often expressed that they paid attention to what their safety trainers said because they are the most knowledgeable people about motorcycle safety. The results of this study also suggest that in addition to educating about a specific skill, trainers or coworkers should help novice individuals develop confident communication skills to accurately convey concerns and stand behind safety choices. For instance, Lavack et al. (2008) argued that individuals who are novice in a skill set, “often lack a sense of empowerment or self-confidence, as well as communication or social skills, making it difficult to question safety” (p. 195). Because novices may perceive trainers or coworkers to be highly credible, the

messages conveyed by those more experienced are extremely important and should entail engaging, empowering dialogue.

Participants discussed that being safer would help preserve their life, whether the safer behaviors prevent an accident or disease. However, the current results demonstrate that peer pressure in both social and workplace cultures can result in risky behaviors to “fit in.” So, trainers and supervisors may find it helpful to, in a way, “sell safety” to their employees, students, or peers, subsequently linking safety with continued quality of life, which may enhance and empower safety choices. For example, supporting the use of PPE such as a helmet, gloves, or reflective gear, at the onset of entering a risk environment, may be efficient and effective in establishing the proper safety mindset. If this type of communication occurs at the forefront of one’s experience, and is provided by people who are perceived as credible and experienced, this could serve as a strategy to change peer pressure to peer support and begin shifting the safety culture perpetuated in risky environments.

What else needs to be communicated about safety? The common external factors revealed in this analysis identify aspects of the sociocultural environment that can help positively influence health and safety choices. However, if organizational leaders or health practitioners remain uncertain about what types of messaging is necessary for a target audience, a similar, culture-centric approach can be used to gather in-depth feedback about the problems of and potential solutions to address organizational and environmental barriers. This approach has been used as a framework to collect qualitative data via formative data collection efforts and has been useful for developing and pretesting health promotion messages with at-risk audiences (Larkey & Hill, 2012; blind citation, under review). Therefore, targeted audience interviews, as the ones reported within this paper, can help reveal cultural barriers that may otherwise remain untapped within the organization. Using this type of feedback can help solve problems but also help develop messages that resonant with that same, at-risk audience. Therefore, if

ever in doubt about what to communicate, embracing a narrative approach with the audience may help find the answer about what needs to be communicated at a specific point in time.

Conclusion

Understanding the interdependent relationships that individuals have with their environment, including adaptation of individuals in their environment, has been argued as a necessity to help maintain and sustain health (Bertalanffy, 1968; Helson, 1964). Furthermore, because health and safety are multifaceted elements, rather than placing decision making at the sole responsibility of the individual, several factors must be considered to aid the overall wellbeing of a population (Peterson & Lupton, 1996). This study took advantage of the opportunity to compare and contrast two populations that engage in risky behaviors within different environments. The opportunity to analyze the hazards, risks, and decisions between these two groups, irrespective of their unique situations, helps identify and understand the primary, external factors that influence risk perceptions and behaviors. Mainly, the results demonstrate that communication and other interventions cannot neglect the environmental factors that promote or hinder risky behaviors. More so, there is a need for placing a greater emphasis on the role the social environment can play in shaping the risks and risk-oriented communication individuals are surrounded by on a daily basis including how they respond to those risks (Rhodes, 2002). Creating environments conducive to safer behaviors, such as enhancing training, providing peer support, and reducing environmental hazards, may help reduce personal susceptibility to risk and harm.

To confirm these external factors are similar across other risky environments, this qualitative risk assessment needs more attention in a variety of settings. However, this paper started the conversation about the importance of communication with influential, experienced individuals in risky environments. Additional cooperation and support may be necessary in the future to create more enabling environments that minimize poor safety culture and address social and structural barriers associated with risk perceptions. Regardless of the limitations present in the current study, however, this paper revealed

important similarities between two different environments that experience high-risk situations. Because the social, cultural, and environmental factors present similar barriers for both motorcyclists and mineworkers, similar efforts in safety and health promotion may be able to be applied to multiple at-risk audiences to support and manage safer behaviors.

References

- Armstrong, D., Gosling, A., Weinman, J., & Marteau, T. (1997). The place of inter-rater reliability in qualitative research: an empirical study. *Sociology, 31*, 597–606.
doi:10.1177/0038038597031003015
- Barnett, J., & Breakwell, G. M. (2001). Risk perception and experience: Hazard personality profiles and individual differences. *Risk Analysis, 21*(1), 171-177. doi:10.1111/0272-4332.211099
- Beharie, N. (2003). New kid on the block. *OH&S Canada, 19*(4), 30-38.
- Bertalanffy, L. V. (1968). *General system theory: Foundations, development, applications*. New York, NY: George Braziller.
- Bonaiuto, M., Breakwell, G. M., & Cano, I. (1996). Identity processes and environmental threat: The effects of nationalism and local identity upon perception of beach pollution. *Journal of Community and Applied Social Psychology, 6*, 157-175. doi:10.1002/(SICI)1099-1298
- Breakwell, G. M. (1996). Risk estimation and sexual behavior: A longitudinal study of 16- 21-year olds. *Journal of Health Psychology, 1*(1), 79-91. doi: 10.1177/135910539600100107
- Breakwell, G. M., Millward, L. J., Fife, C. (1994). Commitment to “safer” sex as a predictor of condom use among 16-20-year-olds. *Journal of Applied Social Psychology, 24*(3), 189-217. doi: 10.1111/j.1559-1816.1994.tb00579.x
- Breslin, C., Koehoorn, M., Smith, P., & Manno, M. (2003). Age related differences in work injuries and permanent impairment: A comparison of workers’ compensation claims among adolescents, young adults, and adults. *Occupational and Environmental Medicine, 3*(60), e10. doi: 10.1136/oem.60.9.e10
- Brewer, N. T., Chapman, G. B., Gibbons, F. X., Gerrard, M., McCaul, K. D., & Weinstein, N. D. (2007). Meta-analysis of the relationship between risk perception and behavior: The example of vaccination. *Health Psychology, 26*(2), 136-145. doi:10.1037/0278-6133.26.2.136

- Bromiley, P., & Curley, S. P. (1992). Individual differences in risk taking. In J. F. Yates (Ed.), *Risk-taking behavior* (pp. 87-132). Chichester, U.K.: John Wiley and Sons.
- Butani, S. J. (1988). Relative risk analysis of injuries in coal mining by age and experience at present company. *Journal of Occupational Accidents, 10*, 209-216. doi:10.1016/0376-6349(88)90014-4
- Centers for Disease Control and Prevention (2012). Helmet use among motorcyclists who died in crashes and economic cost savings associated with state motorcycle helmet laws — United States, 2008–2010. *Morbidity and Mortality Weekly Report, 61*(23), 425-430. Retrieved from <http://www.cdc.gov/mmwr/pdf/wk/mm6123.pdf>
- Cohen, A., & Cleveland, B. (1983). Safety program practices in record-holding plants. *Professional Safety, March Issue*, 26-33.
- Cohen, H., & Jensen, R. (1984). Measuring the effectiveness of an industrial lift truck safety training program. *Journal of Safety Research, 15*, 125-135.
- Corbin, J., & Strauss, A. (2008). *Basics of qualitative research*. 3rd ed. Thousand Oaks, CA: Sage.
- Cummings, K. M., Becker, M. H., & Maile, M. C. (1980). Bringing the models together: An empirical approach to combining variables used to explain health actions. *Journal of Behavioral Medicine, 3*, 123-145.
- Davies, D., & Dodd, J. (2002). Qualitative research and the question of rigor. *Qualitative Health Research, 12*(2), 279-289. doi: 10.1177/104973230201200211
- Deery, H. A. (1999). Hazard and risk perception among young novice drivers. *Journal of Safety Research, 30*(4), 225-236. doi: 10.1016/S0022-4375(99)00018-3
- Diefenbach, M. A., Weinstein, N. D., & O'Reilly, J. (1993). Scales for assessing perceptions of health hazard susceptibility. *Health Education Research, 8*(2), 181–192.

- Elliott, M.A., McColl, V.A., and Kennedy, J.V. (2003). Road design measures to reduce drivers' speed via "psychological" processes: A literature review (TRL Report 564). Crowthorne: Transport Research Laboratory.
- Floyd, D. L., Prentice-Dunn, S., & Rogers, R. W. (2000). A meta-analysis of research on protection motivation theory. *Journal of Applied Social Psychology, 30*, 407-429. doi: 10.1111/j.1559-1816.2000.tb02323.x
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago, IL: Aldine Publishing Company.
- Haas, E. J. (2012). *Toward harm reduction as a metatheory for health communication campaigns: An empirical study of harm reduction metatheory and the Reconceptualized Health Belief Model addressing motorcycle safety*. Unpublished doctoral dissertation, West Lafayette, IN. 558 pp.
- Haas, E. J. & Mattson, M. (2014). *Metatheory and interviewing: Harm reduction and motorcycle safety in practice*. Lanham, MD: Lexington Press.
- Haas, E. J., Mattson, M., & Kosmoski, C. (2012). Incongruent perceptions of driving a motorcycle: Campaign implications for communicating motorcycle safety to drivers of cars and trucks. *International Journal of Motorcycle Studies, 8*(2). Available from: http://ijms.nova.edu/Fall2012/IJMS_Artcl.Haasetal.html.
- Harrison, J. A., Mullen, P. D., Green, L. W. (1992). A meta-analysis of studies of the health belief model with adults. *Health Education Research, 7*, 107-116.
- Healy, C. B., Coggins, M. A., Tongeren, M. V., MacCalman, L., & McGowan, P. (2014). Determination of respirable crystalline silica exposure among stoneworkers involved in stone restoration work. *Annals of Occupational Hygiene, 58*, 6–18. doi:10.1093/annhyg/met045
- Helson, H. (1964). *Adaptation-level theory: An experimental and systematic approach to behavior*. New York, NY: Harper and Row.

- Hewett, P., Morey, S. Z., Holen, B. M., Logan, P. W., & Olsen, G. W. (2012). Cohort mortality study of roofing granule mine and mill workers part I: Estimation of historical crystalline silica exposures. *Journal of Occupational and Environmental Hygiene, 9*, 199–210.
doi:10.1080/15459624.2012.663705
- Irizarry, J., & Abraham, D. M. (2006) Assessment of risk perception of ironworkers. *Journal of Construction Research, 7*, 111-132.
- Janz, N. K., & Becker, M. H. (1984). The health belief model: A decade later. *Health Education Quarterly, 11*(1), 1–47.
- Kahneman, D. & Frederick, S. (2005). A model of heuristic judgment. In KJ Holyoak, RG Morrison (Eds.), *The Cambridge handbook of thinking and reasoning*. New York: Cambridge University Press. pp. 267-293.
- Kosmoski, C., Mattson, M., & Hall, J. (2007). Reconsidering motorcycle safety at Purdue: A case study integrating campaign theory and practice. *Cases in Public Health Communication & Marketing*. Available from <http://www.casesjournal.org>.
- Kowalski-Trakofler, K. M., Vaught, C., Mallett, L. G., Brnich, M. J., Reinke, D.C., Steiner, L.J., Wiehagen, W.J., & Rethi, L.L. (2004). *Safety and health training for an evolving workforce: An overview from the mining industry*. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Information Circular 9794.
- Kreiss, K., & Zhen, B. (1996). Risk of silicosis in a Colorado mining community. *American Journal of Industrial Medicine, 30*, 529–539. doi:10.1002/(SICI)1097-0274(199611)30:5%3C529::AID-AJIM2%3E.3.CO;2-K

- Lajunen, T., & Räsänen, M. (2004). Can social psychological models be used to promote bicycle helmet use among teenagers? A comparison of the health belief model and theory of planned behavior and the locus of control. *Journal of Safety Research*, *35*, 115-123.
- Lajunen, T., & Räsänen, M. (2001). Why teenagers owning a bicycle helmet do not use their helmets. *Journal of Safety Research*, *32*, 323-332.
- Laney, A. S., Petsonk, E. L., & Attfield, M. D. (2010). Pneumoconiosis among underground bituminous coal miners in the United States: is silicosis becoming more frequent? *Occupational and Environmental Medicine*, *67*, 652–656. doi:10.1136/oem.2009.047126
- Larkey, L. K. & Hecht, M. L. (2010). A model of effectiveness of narrative as culture-centric health promotion. *Journal of Health Communication*, *15*(2), 114-135. doi: 10.1080/10810730903528017
- Larkey, L. K., & Hill, A. L. (2012). Using narratives to promote health: A culture-centric approach. In H. Cho, *Health communication message design: Theory and practice* (Eds.), pp. 95-112. Thousand Oaks, CA: Sage Publications.
- Lavack, A. M., Magnuson, S. L., Deshpande, S., Basil, D. Z., Basil, M. D., Mintz, J. H., (2008). Enhancing occupational health and safety in young workers: the role of social marketing. *International Journal of Nonprofit and Voluntary Sector Marketing*, *13*, 193-204. doi:10.1002/nvsm.322
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage.
- Lindlof, T. R. & Taylor, B. C. (2002). *Qualitative communication research methods* (2nd ed.), Thousand Oaks, CA: Sage Publications.
- Loughlin, C., & Frone, M. R. (2004). Young workers' occupational safety. In Frone, B. J., *The psychology of workplace safety* (eds.), pp. 107-125. Washington, DC: American Psychological Association.

- Mattson, M. (1999). Toward a reconceptualization of communication cues to action in the Health Belief Model: HIV testing counseling. *Communication Monographs*, 66, 240-263.
- Miles, M. B., & Huberman, M. A. (1994). *Qualitative analysis: An expanded sourcebook* (2nd eds.), Thousand Oaks, CA: Sage Publications.
- Mine Health and Safety Administration (MSHA) (2014). Remote controlled continuous mining machine fatal accident analysis report of victim's physical location with respect to the machine. Retrieved from <http://www.msha.gov/webcasts/Coal2005/Fatal%20Accident%20Summary.pdf>
- Mullin, B., Jackson, R., Langley, J., & Norton, R. (2000). Increasing age and experience: are both protective against motorcycle injury? A case control study. *Injury Prevention*, 6, 32-35. doi: 10.1136/ip.6.1.32
- National Highway Transportation Safety Administration (2014). Traffic safety facts 2012 data: Motorcycles. Retrieved from <http://www-nrd.nhtsa.dot.gov/Pubs/812035.pdf>
- National Highway Transportation Safety Administration (2010). Traffic safety facts 2008 data: Motorcycles. Retrieved from <http://www.nhtsa.dot.gov/portal/site/nhtsa/menuitem.d7975d55e8abbe089ca8e410dba046a0/>
- National Highway Traffic Safety Administration (2000). National agenda for motorcycle safety: Human factors, motorcyclist attitudes. Retrieved from <http://www.nhtsa.gov/people/injury/pedbimot/motorcycle/00-nht-212-motorcycle/toc.html>.
- National Institute for Occupational Safety and Health (NIOSH) (2003). Work-related lung disease surveillance report, 2002. DHHS (NIOSH) Numbered Publication 2003-111.
- Nelkin, D. (1989). Communicating technological risk: The social construction of risk perception. *Annual Review of Public Health*, 10, 95–113.

- Olofsson, A., & Öhman, S., (2015). Vulnerability, values and heterogeneity: one step further to understand risk perception and behaviour. *Journal of Risk Research*, 18(1), 2-20. doi: 10.1080/13669877.2013.879485
- Perloff, L. S. & Fetzer, B. K. (1986). Self-other judgments and perceived vulnerability to victimization. *Journal of Personality and Social Psychology*, 50, 502-511.
- Perlman, A., Sacks, R., & Barak, R. (2014). Hazard recognition and risk perception in construction. *Safety Science*, 54, 22–31.
- Peters, R. H., Vaught, C., & Mallett, L. (2010). A review of NIOSH and US Bureau of mines research to improve miners' health and safety training. *Extracting the science: A century of mining research* (pp. 501-509). JF Brune (Ed.), Littleton, CO: Society of Mining, Metallurgy, and Exploration.
- Peterson, A., & Lupton, D. (1996). *The new public health and self in the age of risk*. Newbury Park, CA: Sage Publications.
- Pidgeon, N. (1999). Risk communication and social amplification of risk: Theory, evidence and policy implications. *Risk, Decision and Policy*, 4(1), 1-15.
- Pidgeon, N. (1991). Safety culture and risk management in organizations. *Journal of Cross Cultural Psychology*, 22(1), 129-140.
- Raeburn, J., & Beaglehole, R. (1989). Health promotion: can it redress the health effects of social disadvantages? *Community Health Studies*, 13, 289-293.
- Rhodes, T. (2002). The “risk environment”: A framework for understanding and reducing drug-related harm. *International Journal of Drug Policy*, 13, 85-94. Available at [http://dx.doi.org/10.1016/S0955-3959\(02\)00007-5](http://dx.doi.org/10.1016/S0955-3959(02)00007-5)
- Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. *Journal of Psychology*, 91, 93-114. doi:10.1080/00223980.1975.9915803

- Rosenbloom, T., Perlman, A., & Pereg, A. (2011). Hazard perception of motorcyclists and car drivers. *Accident Analysis & Prevention, 43*, 601-604. doi:10.1016/j.aap.2010.08.005
- Rundmo, T. (2001). Employee images of risk. *Journal of Risk Research, 4*(4), 393–404. doi: 1080/136698701100653259
- Salminen, S. (2004). Have young workers had more injuries than older ones? An international literature review. *Journal of Safety Research, 35*, 513-521.
- Scarselli, A., Binazzi, A., Forastiere, F., Cavariani, F., Marinaccio, A. (2011). Industry and job-specific mortality after occupational exposure to silica dust. *Occupational Medicine, 61*, 422–429. doi:10.1093/occmed/kqr060
- Sjöberg, L. (1995). Explaining risk perception: An empirical evaluation of cultural theory (Risk Research Reports No. 22). Stockholm School of Economics, Stockholm: Rhizikon.
- Sjöberg, L. (2000). Consequences matter, “risk” is marginal. *Journal of Risk Research, 3*, 287–295.
- Siu, O., Phillips, D. R., & Leung, T. (2003). Age differences in safety attitudes and safety performance in Hong Kong construction workers. *Journal of Safety Research, 34*, 199-205. doi: 10.1016/S0022-4375(02)00072-5
- Thomson, G. A. (1980). The role front motorcycle conspicuity has in road accidents. *Accident Analysis & Prevention, 12*(3), 165-178. doi:10.1016/0001-4575(80)90015-9
- Tichon, J. & Burgess-Limerick, R. (2011). A review of virtual reality as a medium for safety related training in mining. *Journal of Health & Safety Research & Practice, 3*(1), 33-40.
- Turner, G., & Wynne, B. (1992). Risk communication. In J. Durant (Ed.), *Biotechnology in public: A review of recent research* (pp. 109-141). London: Science Museum for the European Federation of Biotechnology.

- Vacek, P. M., Verma, D. K., Graham, W. G., Callas, P. W., & Gibbs, G. W. (2011). Mortality in Vermont granite workers and its association with silica exposure. *Occupational and Environmental Medicine*, *68*, 312–318. doi:10.1136/oem.2009.054452
- Wahlström, B. (1992). Avoiding technological risks: The dilemma of complexity. *Technological Forecasting and Social Change*, *4*, 351–365. doi:10.1016/0040-1625(92)90079-9
- Webel, A. R., Okonsky, J., Trompeta, J., & Holzemer, W. L. (2009). A systematic review of the effectiveness of peer-based interventions on health-related behaviors in adults. *American Journal of Public Health*, *100*(2), 247–253. doi:10.2105/AJPH.2008.149419
- Weinstein, N. D. (1984). Why it won't happen to me: Perceptions of risk factors and susceptibility. *Health Psychology*, *3*(5), 431–457. <http://dx.doi.org/10.1037/0278-6133.3.5.431>
- Weinstein, N. D. (1987). Unrealistic optimism about susceptibility to health problems: Conclusions from a community-wide sample. *Journal of Behavioral Medicine*, *10*(5), 481–500.
- Weinstein, N. D. (1988). The precaution adoption process. *Health Psychology*, *7*, 355–386.
- Weinstein, N. D. (1989). Optimistic biases about personal risks. *Science*, *246*, 1232–1233. doi: 10.1126/science.2686031
- Weinstein, N. D. (1999). What does it mean to understand risk? Evaluating risk comprehension. *Journal of the National Cancer Institute Monographs*, *25*, 15–20.
- Weyman, A., & Clark, D. D. (1999). Investigating the influence of organizational role on perceptions of risk in deep coal mines. *Journal of Applied Psychology*, *88*(3), 404–412.
- Weyman, A., Clarke, D. D., & Cox, T. (2003). Developing a factor model of coal miners' attributions on risk-taking at work. *Work & Stress*, *17*(4), 306–320. doi:10.1080/02678370310001646844
- Wilson, F. A., Stimpson, J. P., & Hilsenrath, P. E. (2009). Gasoline prices and their relationship to rising motorcycle fatalities, 1990–2007. *American Journal of Public Health*, *99*(10), 1753–1758. doi: 10.2105/AJPH.2009.159590

Willis, T. A. (1981). Downward comparison principles in social psychology. *Psychological Bulletin*, 90(2), 245-271.

Zohar, D. (1980). Safety climate in industrial organization: Theoretical and applied implications. *Journal of Applied Psychology*, 65(1), 96-102.

Zohar, D., & Erev, I. (2007). On the difficulty of promoting workers' safety behavior: Overcoming and underweighting of routine risks. *International Journal of Risk Assessment and Management*, 7(2), 122-136. doi:10.1504/IJRAM.2007.011726

Zuckerman, M., Ball, S., & Black, J. (1990). Influences of sensation seeking, gender risk, appraisal and situational motivation on smoking. *Addictive Behaviors*, 15, 209-220.

Zuckerman, M. (1994). *Behavioral expressions and biosocial bases of sensation seeking*. Cambridge: Cambridge University Press.